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14. ABSTRACT The telerehabilitation for OEF/OIF returnees with mild or moderate combat related Traumatic Brain Injury (TBI) has as its objectives 1) care coordination for wounded veterans using distance technology via the internet and 2) monitoring of physical and mental health outcomes using a variety of instruments. To date we have enrolled 75 veterans and are actively following 48 in the study. We have collected baseline, 6, 12 and 18 month health status data on most veterans. Our findings indicate that 1) Functional capabilities measured by locomotion and mobility appear to have stabilized among our cohort of veterans while deficiencies in cognition (memory, problem solving), psychosocial adjustment (anger, emotional status) and problems in integrating into society pose challenges 2) Those with comorbid PTSD appear to display more erratic rehabilitation trajectories in cognition improvement and ultimate integration into society as compared to those without the diagnosis 3) Individualized treatment pathways are needed for rehabilitation and ultimate integration into society and 4) Veterans have expressed appreciation for the program.					
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Telerehabilitation for OIF/OEF Returnees with Combat-Related Traumatic Brain Injury.

Introduction

Goals: This is one project in a planned program of research to improve care for injured Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) veterans. We propose with this study to test a telerehabilitation program for veterans with combat related traumatic brain injury (TBI) with or without comorbid post traumatic stress disorders (PTSD) by monitoring functional, cognitive and mental health outcomes together with their integration into society using a variety of instruments. Coordinating medical care at a distance and thereby reducing their utilization of the VA health system is another important goal of this telerehabilitation intervention.

The *long term* goal of this program of research is to optimally define telerehabilitation services for all veterans with polytrauma, including accurate and efficient screening instruments, educational material for patients and families, family support, and family counseling to enhance care coordination and to maximize functional outcomes and quality of life.

The Telerehabilitation intervention: Veterans who meet the inclusionary criteria of a clinical diagnosis of combat incurred mild or moderate TBI in Iraq and Afghanistan and who utilize the James A. Haley (JAH) Veterans Hospital in Tampa, FL as their primary source of care and who in the opinion of care providers in the Polytrauma Clinic at JAH will possibly benefit from the program are eligible to be consented for participation. They are provided Dell® laptop computers to communicate at least once weekly on a secured VA server with the care coordinator (Ms. Susan Brock, ARNP) who also meets them at their scheduled outpatient visits at the JAH. The RN helps in a variety of care coordination efforts including scheduling appointments with specialists, medication management, counseling and monitoring outcomes. The RN coordinates care for Post Traumatic Stress Disorders (PTSD) with a clinical psychologist at the JAH.

Challenges in care delivery: Our challenge has been establishing a “secure virtual highway” to conduct the telerehab intervention. The VA has no national program for providing individualized care coordination for veterans via telemedicine. It does have an e-health portal where veterans may submit and track vital signs such as BP readings and cholesterol levels but one that does not provide for individualized care.

The Veterans Integrated Service Network 8 (VISN 8) which includes the JAH currently uses the Health Hero patient management system and uses store and forward technology using the Health Buddy and web based solutions as part of its program to support patients with chronic conditions such as Congestive Heart Failure, diabetes, hypertension, COPD and mental illness. However, this technology does not allow for the posting of individualized questions for tracking health conditions and care coordination a key component of our proposed telerehabilitation intervention.

Home visit to assess functional status and home environment: The Physical Medicine and Rehabilitation Service at the JAH provides a service wherein visits to the homes of combat injured veterans are made by qualified Occupational Therapists who add functional aids such as hand rails and ramps for wheel chairs in the homes to aid in ambulatory function. Other assistive devices include modifications to the kitchen to accommodate the needs of the veterans. The cost to the VA is limited to \$2,000 per veteran.

Monitoring health outcomes; Veterans are required to connect (via the internet) to a secured commercial website (SurveyMonkey.comTM) to provide responses to a variety of instruments to monitor their health outcomes over time including the Functional Independence and Functional Assessment MeasureTM (FIM/FAM), the Craig Handicap Assessment and Reporting Technique (CHART), the PTSD Checklist Military Form, Modified PTSD Symptom Scale, Self-Report Alcohol Use Disorders Identification Test (AUDIT), Self Report Beck Depression Inventory and the Medical Outcomes Social Support Survey.

Research team: The telerehabilitation care coordination team is organized under a primary care physician, namely, Steve G. Scott, DO, Chief Physical Medicine and Rehabilitation Services VA. Andrea M. Spehar, DVM, MPH, JD is the Program Manager and a Co-Investigator. Two full time polytrauma nurses,

Susan Brock, ARNP and Maria Morales, RN, aid in recruiting veterans to the study, as well as providing care coordination. Assisting them is William A. Lapcevic, MSST, MPH an expert in information technology and data management. Scott Barnett, PhD is the biostatistician.

Project extension: The Congressionally Directed Medical Research program has extended the period of performance for this grant by one year to June 30, 2012 so we may complete our assigned statement of work as indicated below. The study is now slated to cover a period of 48 months from initiation.

Body

The following tasks have been completed with additional details below.

Task 1. Administrative tasks, Months 1-3:

Completed

- a. Obtain Institutional Review Board and conduct literature review.
- b. Recruit LAMP coordinator care coordination RN.
- c. Recruit technical personnel (LAMP technician) and software analyst.
- d. Order computers, load software programs/dialogues and set up web site on VA servers.

Task 2. Patient recruitment and programming, Months 3-32:

Completed

1. Finalize list of all OEF/OIF returnees discharged from the Tampa PT/BRI Center with a primary or secondary diagnosis of TBI.
2. Contact (phone/internet/mail) patients who meet inclusion criterion and agree to participate and have informed consents signed.

Task 3. Initial home visits to assess functional status and home environment, Months 3-32: **Completed.**

1. Conduct initial home visit to assess functional status and home environment
2. Make recommendations for assistive devices and environmental interventions
3. Purchase assistive technology through appropriate VA providers and provide training.
4. Set up the dialogues.

Task 4. Data Collection: Months 5-40:

Ongoing

1. Abstract from the Veterans' health Information Systems & Technology Architecture (Vista) medical record abstracts pertaining to health care utilization and treatments of TBI patients.
2. Abstract from the VA Decision Support System (DSS) cost estimates of VA Health Care Utilization.
3. Download responses to patient inputs to aforementioned survey instruments.
4. Conduct patient/caregiver satisfaction surveys and perceptions on facilitators and barriers to telerehabilitation.

Task 5. Data Analysis: Months 32-46:

Ongoing

1. Conduct statistical analysis to determine:
 - a.Changes in functional status and community integration
 - b.Satisfaction with assistive devices and technology
 - c.Changes in patterns of healthcare utilization and associated costs
 - d.Satisfaction with TBI LAMP
2. Conduct interviews to synthesize facilitators and barriers to providing telerehabilitation for TBI.

Task 6. Final Analyses and Report Writing: Months 48-54: **To Be Addressed**

- a. Prepare final report and initial manuscripts: **Ongoing.**

Patient characteristics

Demographics: We are actively following 48 veterans of a total of 75 who have consented to the telerehabilitation study. Some of the injured were transferred from Walter Reed Army Medical Hospital to the Physical Medicine and Rehabilitation Service at the JAH and were subsequently discharged but still utilize the outpatient services at the JAH. Others were discharged from other military or VA facilities and chose to reside in the Tampa area partly due to the availability of health care at the JAH. One of our enrollees is a female who sustained TBI due to indirect fire. Table 1 provides for a breakdown of race and ethnicity among enrollees at initial consent to participate in the study.

(N=75)	TBI N=61	TBI/PTSD N=14
	N (%)	N (%)
Male, %	58 (95.1)	14 (100.0)
Age group (yr), %		
18-29	36 (59.02)	3 (21.43)
30-39	15 (24.59)	3 (21.43)
40-49	7 (11.48)	7 (50.00)
50+	3 (4.92)	1 (7.14)
Age, mean \pm SD	31.1 (8.4)	37.9 (9.0)
Marital status		
Married	32 (52.5)	7 (50.0)
Divorced	5 (8.2)	1 (7.1)
Never Married	20 (32.8)	6 (42.9)
Single	4 (6.6)	0 (0.0)
Ethnicity, %		
Not Hispanic	44 (72.1)	9 (64.29)
Hispanic or Latino	15 (24.6)	4 (28.57)
Unanswered	2 (3.3)	1 (7.14)
Race, %		
White	50 (82.0)	10 (71.4)
Black	4 (6.6)	0 (0.0)
Native Hawaiian	2 (3.3)	1 (7.1)
Unanswered	5 (8.2)	3 (21.4)
Race/Ethnicity, %		
White	39 (63.9)	8 (57.1)
Black	4 (6.6)	0 (0.0)
Hispanic	15 (24.6)	4 (28.6)
Native Hawaiian	1 (1.6)	1 (7.1)
Unanswered	2 (3.3)	1 (7.1)
Service Connected, %		
0%	17 (27.9)	5 (35.7)

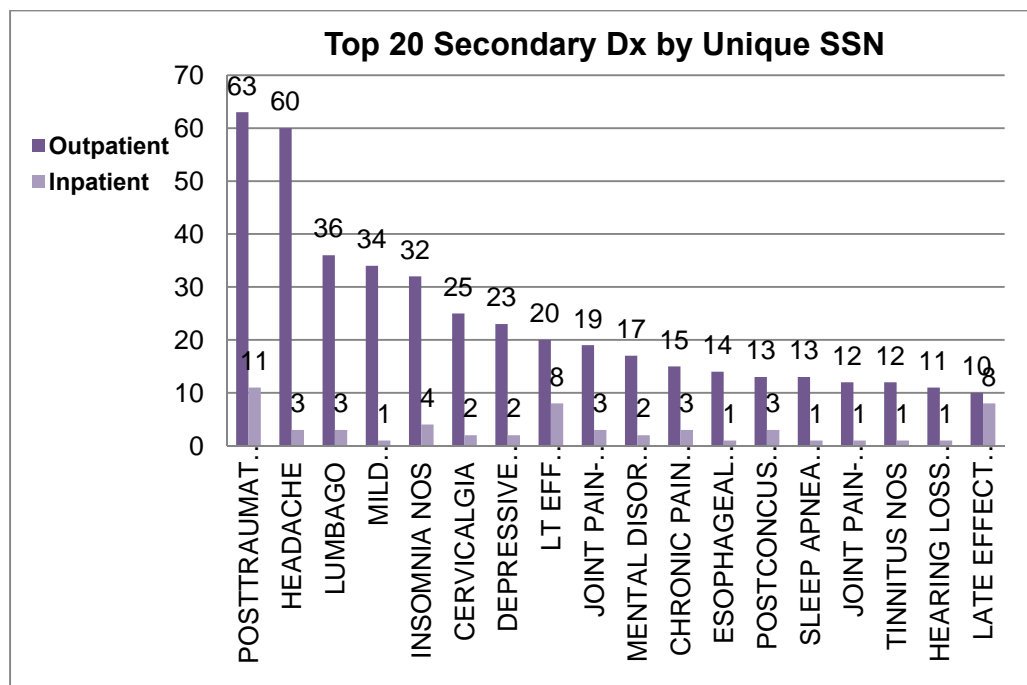
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10-30%	10 (16.4)	0 (0.0)
40-60%	14 (23.0)	3 (21.4)
70-80%	9 (14.8)	3 (21.4)
80-100%	11 (18.0)	3 (21.4)
Annual Income, %		
\$0-9,999	18 (29.5)	3 (21.4)
\$10,000-29,999	25 (41.0)	6 (42.9)
\$30,000-49,999	13 (21.3)	4 (28.6)
\$50,000-79,999	2 (3.3)	1 (7.1)
\$80,000+	3 (4.9)	0 (0.0)

Health Status

As per the inclusionary criteria for participation in telerehabilitation all veterans have a primary clinical diagnosis of Traumatic Brain Injury incurred in combat theatres in Iraq and Afghanistan. Though the mechanism of injury is not always identified in their medical charts in the VA, conversations with wounded warriors has revealed that the majority suffer from the effects of blast related injuries resulting from improvised explosive devices and mortar attacks. Many of the wounded suffer from the many adverse side effects of TBI. The counts of secondary diagnosis illustrated in Figure 1 are for unique veterans but are mutually inclusive in that the same diagnosis may be recorded twice for the same veteran at outpatient visits or at inpatient admissions. As can be observed, Post Traumatic Stress Disorders and the adverse effects of TBI manifested as headaches, sleep disorders and cognitive impairment were common ailments of our study cohort.

Figure 1: Secondary diagnosis among veterans recorded during inpatient (n=11) and outpatient (n=63) visits.



As can be observed, Post Traumatic headaches and the adverse effects of TBI manifested as musculoskeletal disorders and cognitive impairment were common ailments of our study cohort. This is clearly indicated in the care coordination provided to veterans with the issues pertaining to cognition and psychosocial complications requiring urgency and providing challenges in providing care. Substance abuse, involving prescribed medications, alcohol and street drugs also complicates treatment.

Baseline Surveys

We have collected data as required by our protocol on a variety of functional, cognition, social integration and mental health outcomes to evaluate the efficacy of the telerehab intervention. As may be noticed many of the instruments have overlapping questions in the areas of function, cognition and psychosocial adjustments. Yet each instrument has its own peculiarity in assessing veterans' health status and has independently been shown to provide for reliability and validity in measurement. We therefore have maintained the integrity of each instrument and have not altered any of the questions posed. Repeated measures will be conducted over time and appropriate statistical analysis will reveal changes over time as indicated in the initial protocol and statement of work.

The aim of gathering information is twofold: 1) To characterize rehabilitation trajectories over time in the areas of function, cognition, psychosocial adjustment, integration into society and mental health disorders over time and 2) To individualize treatment patterns customized to each veterans needs so as to maximize the effect of telerehabilitation. Unlike traditional telemedicine that deals with disease specific monitoring or intervention (diabetes, CHF, dementia etc), our cohort exhibits a very diverse population in terms of disease affliction, complexity and propensity to respond to care.

1. **Functional Independence Measure™ (FIM) and Functional Assessment Measure (FAM):** The (FIM™)^{1,2} is a widely accepted functional assessment measure in use in the rehabilitation community. The FIM measures independent performance in motor and cognitive skills in addition to the ADLs pertaining to the self care categories of feeding, grooming, bathing, dressing upper body, dressing lower body and toileting. The FIM is proprietary. We have therefore captured all elements of the FIM in an expanded version of the same which includes elements in Functional Assessment as well. Because disturbances in communication, cognition, and behavior are prominent characteristics after brain injury, additional items considering those issues were added to the FIM, resulting in a functional assessment measure, FIM+FAM.³ The FIM+FAM has been increasingly adopted as an outcome measure in brain injury rehabilitation.^{4,5}
2. **Craig Handicap Assessment and Reporting Technique (CHART):** The CHART provides for assessing assistance levels, time spent (and with whom) and financial resources. The standard deviations in Table 4 indicate variability among veterans in each of the categories listed substantiating our prior finding that our cohort is binary in nature on care needs especially in the areas of cognition and integration into society.
3. **Patient Competency Rating Scale (PCRS):** The PCRS provides for a rating of basic competencies in performing everyday chores with responses on a 1-5 scale with 1 denoting the most difficulty in addressing a problem and a score of 5 implying ability to handle the problem with total ease.

Findings: We have condensed the major findings from the FIM + FAM, CHART and PCRS in Table 4. Table 4 provides for the N, means and standard deviation of self scoring by veterans at baseline, 6, 12, 18, 24, 30 and 36 months after enrollment. The cohort in general performed well in self care items such as grooming, feeding, bathing and dressing as well as toileting. Except for one veteran confined to a wheelchair, as a group

they indicated good mobility and locomotion as expressed by transfers to chairs, cars, climbing stairs and using the tub or shower. Communication skills as contained in reading and verbalizing were adequate. As clearly evident psychosocial adjustment and cognitive function are the main areas of concern in coordinating care. Depression, anger, substance abuse, inability to integrate into society and post traumatic stress disorders of varying magnitude and complexity afflict many returnees with wounds incurred in war. Emotional outbursts are fairly frequent among this population.

Our care coordination therefore has been mostly directed towards facilitating psychological counseling and psychiatric care. Due to the shortage of mental health experts in the VA compared to the large number of veterans who require this service our efforts at obtaining the needed care for our cohort has been challenging.

Table 1: FIMFAM, CHART & PCRS Domain Scores (Mean ± Standard Deviation) over Time

MEAN±STD DOMAINS	<i>BASELINE</i> <i>N=65</i>	<i>6 MO</i> <i>N=51</i>	<i>12 MO</i> <i>N=47</i>	<i>18 MO</i> <i>N=44</i>	<i>24 MO</i> <i>N=33</i>	<i>30 MO</i> <i>N=24</i>	<i>36 MO</i> <i>N=10</i>
FIMFAM							
FIMFAM Score	176.2±33.5	177.4±29.4	178.9±26	177.9±27.6	177.6±28.5	178.3±29.7	168.6±34.7
FIM Score	109.8±18.4	111.2±14.6	111.8±13.3	111.2±13.5	111.9±14.7	111.2±14.1	106.4±17.8
Self Care Items	45.6±6.3	45.2±6.1	45.9±5.5	45±5.6	45.4±5.8	45.3±5.3	42.8±8.1
Sphincter Control	13.3±1.7	13.3±1.8	13.3±1.3	13.4±1.3	13.4±1.5	13.5±0.8	13±1.9
Mobility Items	26.3±4.3	26.7±2.6	26.6±3.5	26.7±2.1	26.8±2.2	27±1.6	26.2±3.6
Locomotion	18.9±3.3	18.8±3.1	18.7±3.3	18.7±2.9	18.2±3.2	19.4±2.1	16.8±4.4
Communication Items	30±5.7	29.5±5.8	30.4±5.4	29.5±5.8	29.7±5.8	31±3.8	27.3±5.5
Psychosocial Adjustment	19.8±7.2	19.3±7.7	19.1±6.5	19.5±7	18.5±7	20.3±6.4	18.6±7.9
Cognitive Function	24.7±7.8	24.5±7.8	25.4±6.6	25.1±7.4	25.7±6.8	25.9±6.6	23.9±9
CHART							
Physical Independence	85.4±34.5	87.3±28.5	87±28.6	85.8±27.9	84.4±29.2	83±44.6	73.6±55.7
Cognitive Independence	66.8±28.5	58.1±29.4	63.4±30.2	61.5±32.4	64.5±25.7	68.8±31.3	61.2±29.5
Mobility	79.6±24.1	78.9±23.4	78.7±25.1	78.9±20.7	74.3±24.4	81.8±25.1	86.3±16.8
Occupation	69.8±36.9	71±36.6	71.9±39.2	69±36.4	64.4±41	76.9±34.6	75±38.5
Social Integration	83.9±22.2	75.3±25.5	79.7±22	75.7±23.9	73.6±26.5	69.7±27.2	74.1±26.3
Economic Self Sufficiency	81±24.2	79.7±27.2	77.4±26.5	77.8±29.9	75.7±30.3	84.9±26.1	88.2±24.7
PCRS							
Patient Competency Rating Score	91±16.2	90.9±20.6	94.4±21.1	94.7±22.9	91.5±19.7	98.3±20.8	93±24.6

Effect of PTSD on Psychological Adjustment and Cognition

Figures 2 and 3 indicate the adverse effect of comorbid PTSD on Psychological Adjustment and cognition as measured by repeated measures of the same using the Functional Independence Measure. The clear divergence in domain scores over time is reflected in the former's inability to gainful employment and ultimate integration into society. Law and order issues and substance abuse are also more characteristic of this group.

Figure 2: Change in Psychological Adjustment scores: TBI only (red) and with comorbid PTSD (blue)

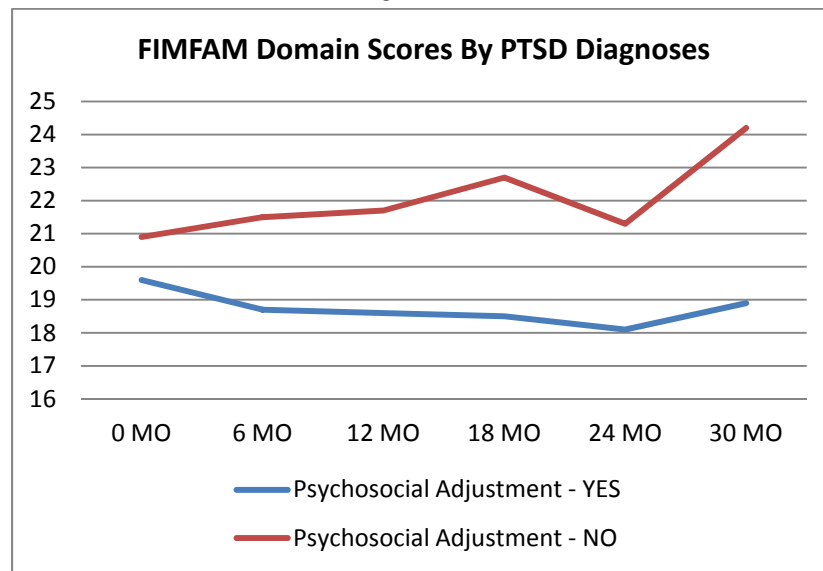
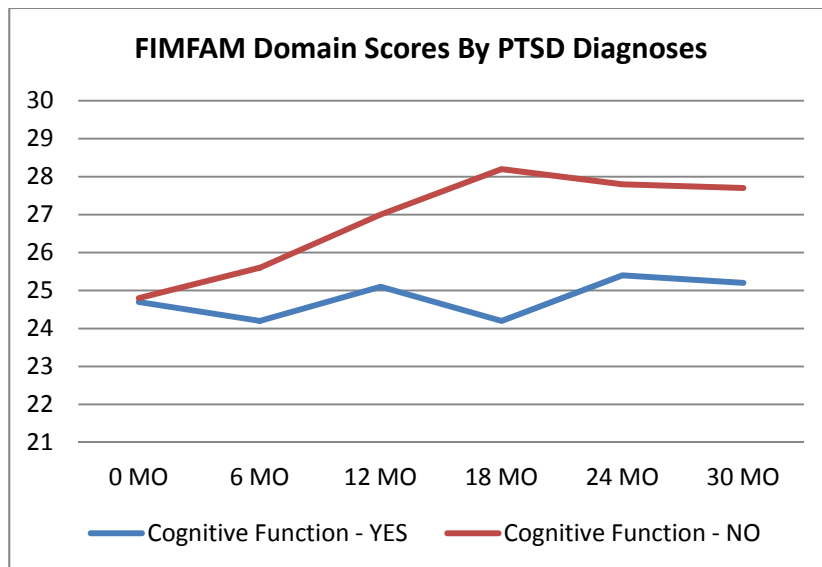


Fig 3: Change in Cognition Domain scores: TBI only (red) and with comorbid PTSD (blue)



Patient satisfaction surveys

Our continuing patient satisfaction surveys reveal the enrollees are highly appreciative of the care provided as indicated in Table 7 with the scoring mechanism on a Likert scale with 5 denoting strongly agreeing and 1 equal to a strong disagreement to the question posed. We consider care coordination as one of the key accomplishments of our intervention. The number of missed diagnosis uncovered, medication profile resets, drug tapering and the timely scheduling of appointments are too numerous to enumerate in this report. An insight into the improved quality of care resulting from this effort is contained in the satisfaction survey. Veterans rated the interventionist (Ms. Sue Brock, ARNP) highly for her caring nature in providing care coordination and overwhelmingly rated the telerehabilitation intervention as superior to traditional VA care

obtained at the Tampa VA. We have included in the Appendix a verbatim sampling of the messages of appreciation.

Table 2: Patient satisfaction survey

Question	N	Mean	Median	Std Dev
Q1 The Telerehab website was easy for me to use.	51	4.55	5	0.54
Q2 I found the Telerehab communications convenient.	51	4.69	5	0.51
Q3 I found the amount of time the Telerehab communications take to be about right.	51	4.47	5	0.61
Q4 I found the time between Telerehab communications about right.	51	4.35	4	0.63
Q5 The RN (Sue Brock) returned my messages in a timely manner.	51	4.92	5	0.27
Q6 The RN was able to provide the services requested.	51	4.82	5	0.43
Q7 The overall care and services provided by the RN met my needs.	51	4.84	5	0.37
Q8 When I had questions about care coordination the answers provided were helpful to me.	51	4.69	5	0.73
Q9 I had no concerns about whether the privacy of personal medical information was protected.	51	4.63	5	0.66
Q10 The Telerehab care coordination was more convenient than arranging through the James A Haley Veteran's Hospital.	50	4.78	5	0.51
Q11 The Telerehab communications can substitute for some visits to the James A Haley Veteran's Hospital.	49	4.22	4	0.85
Q12 Overall, I am satisfied with the Telerehab service I am enrolled in.	51	4.78	5	0.42

Key Research Accomplishments:

Reportable Outcomes: We have presented our initial findings at the *NATO Symposium on Mental Health and Well Being across the Military Spectrum* in Bergen, Norway in April 2011 and will repeat at upcoming Military Operational Medicine Research program IN Progress review meeting at Ft. Detrick, MD in July 2011. Findings will be published in peer-reviewed medical journals such as the VA Journal of Rehabilitation Research and Development and the US Army Medical Journal and presented at national meetings, such as VA HSR&D and appropriate conferences organized by the DOD. The results of this research will be presented at the annual PT/BRI conference sponsored jointly and hosted annually by the Tampa VA, the Defense and Veterans Brain Injury Center and the University of South Florida. In addition to the usual methods of dissemination, the main audience for research findings is clinical staff at the four PT/BRI Centers. We are presently preparing the first of manuscripts for publication in peer reviewed journals highlighting our findings.

Presentations:

1. Siddharthan K, S Barnett, SM Brock, WA Lapcevic, AM Spehar. Telerehabilitation for Veterans with Combat related TBI/PTSD. *Proceedings: NATO Symposium on Mental Health and Well Being*

across the Military Spectrum. Bergen, Norway, April, 2011

2. K Siddharthan, S Barnett, SM Brock, WA Lapcevic, AM Spehar. *Telerehabilitation for combat wounded with Traumatic Brain Injury (TBI) and Post Traumatic Stress Disorders (PTSD)*. James A. Haley Veterans Hospital Research Day (April 29, 2010).
3. K Siddharthan, S Barnett, SM Brock, WA Lapcevic, AM Spehar. *Effect of comorbid PTSD on psychosocial adjustment among combat wounded veterans*. VA Mental Health Conference, Little Rock, AK, April 2010

Conclusion.

The major findings our research so far indicates:

1. Functional capabilities measured by locomotion and mobility appear to have stabilized among our cohort of veterans while deficiencies in cognition (memory, problem solving), psychosocial adjustment (anger, emotional status) and problems in integrating into society pose challenges.
2. Headaches, depression and other Post Traumatic Stress disorders appear to afflict a majority of patients.
3. Individualized treatment pathways are needed for rehabilitation and ultimate integration into society.
4. Veterans have expressed appreciation for the program.

A description of work to be performed during the next reporting period.

We have ended recruitment, but we will continue following our veteran subjects and collecting survey data, as well as providing our assistance in their care coordination. We have started multivariate modeling of changes over time and will be preparing the first of our manuscripts detailing our findings in the near future.

The US Army Medical Research and Military Command has provided additional funding to enhance the robustness of our telerehab study by expanding our present research into a randomized control study (RCT). We will follow a total of 100 combat wounded veterans (50 receiving the telerehab intervention) and 50 others as the control group who receive traditional care equally split between the Tampa VA and Miami VA. Such an RCT would greatly enhance the power of our study and enable investigation into the cost effectiveness of telerehabilitation and the time trajectories of various health outcomes while adjusting for confounders, characteristics that our present study lacks.

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Appendix

Veteran JP writes:

Thank you so much Sue !

I'm sorry, I forgot... Happy Valentines Day!!! I will keep in touch, I'm not sure if anyone else tells you, "your great, at times, just hearing from you feels like the weight of the world has been lifted off my shoulders... Knowing that your out here is like knowing I have a Guardian Angel looking out for me".

Thank you for the Support you are giving our Country! With out people like yourself, this Country would of never made it to where it is...

Hi Sue,

I'd like to start off by thanking you for all your help. Honestly, I would be lost if I didn't have someone like you to remind me and be there to answer questions for me.

Veteran JM:

Need to be seen tomorrow. I have class 2-3pm. I need to see a Dr. and get xrays put in to see the damage. Can you make that happen with my short notice and around my class time. Like after 3 or from like 12 to 1.

Thanks

Jason Mckean

I only authorize you to call me. 813-xxx-xxxx. I don't want any other ppl calling me ever. I'm very anti VA right now.

Veteran FB:

thank you youe are always on top of things thank you for benn so helpful.

Veteran IH:

Hey Sue, if I told you everything I have gone through the last 6 months with this whole insurance, primary dr and back pain....you would want to call the top person at the VA!! I am one step from paying out of pocket for help and care. And now I need surgery to repair the initial surgery I had to repair my abdominal hernia. I'm SURE that I will never get repaired properly by competant dr's and ones that aren't so pesimistic about my recovery.

So, how you been? Sorry to vent but so far you haven't promised anything that you didn't come through with. Can you take over the care of all vets?? Thanx for everything and I'll keep you informed of my situations.

Have a great day

Can I have another update on my schedule, it is something I still struggle with. I know I have some appointments this month and I wake up everyday worried I have skipped one. How much longer will this program be available? I enjoy having a means to a consistent personal relationship with the va and get answers to simple questions as well as have direct concern over my well being. I check my email hoping to have a message from this site and have come to depend on the little updates I receive. Thank you for continuing the program thus far.